

## **WATERTON BIOSPHERE RESERVE**

### **Periodic Review Report, 1997**

This report is in three sections. The first summarizes the main findings and conclusions of the reviewer. The second is a narrative to highlight main events and activities of the biosphere reserve since its inception, and the context within which these occurred. The third section is the completed Periodic Review Form.

The site visit for this periodic review was made on August 18-21, 1997, to gather background documentation and meet with the people most directly involved in the Waterton Biosphere Association. Their help and hospitality was most appreciated. Special acknowledgement is extended to Larry Frith, Chair of the Waterton Biosphere Association, Bill Dolan, Chief Park Warden, and Kevin Van Tighem, Conservation Biologist, Waterton Lakes National Park, for help in gathering material needed for the documentation required by the periodic review, and discussing topics associated with it. Although they commented upon a first draft, the points emphasized in this report, as well as any errors, are those of the reviewer.

George Francis,  
University of Waterloo,  
Reviewer on behalf of the Canadian Commission for UNESCO and Canada/MAB.

29 September 1997.

### **I. Main Findings and Conclusions**

1. The activities of the Waterton Biosphere Reserve since its inception have been conducted by a relatively small group of from 6-8 people working as volunteers. They have been supported by a \$5,000 annual grant from Parks Canada to help defray out-of-pocket expenses. The group has been made up of local residents, mainly livestock ranchers from locations near the national park boundary, and from 1-3 senior park staff. By 'tradition' the successive Chairpersons of the group have been local ranchers. The group has no staff of its own. Additional funds for projects or events have to be solicited from other sources, and the activities are carried out either by volunteers or with staff from agencies and organizations assigned to particular biosphere reserve projects. The group meets about eight times a year.

2. During the 1980s, the biosphere reserve group was constituted informally as a 'management committee'. It also established an informal 'technical advisory committee' of professionals to help with research and other projects. Under these arrangements, a number of collaborative research projects were undertaken to address issues of wildlife, cattle and range management that were of concern to both ranchers and park staff. Several of these led to policy or management changes. The group also arranged for public seminars on topics of interest and public forums for issues of immediate concern in the community.

3. By the early 1990s, changes occurred both in the biosphere reserve group and in the context within which they worked. Over a period of 2-3 years, several people who had been leaders in the biosphere reserve group moved away from the Waterton area. Government funding for projects carried out to meet interests of non-governmental organizations or local communities all but 'dried up'. The technical advisory committee became inactive, and in response to budget reductions, government agencies generally became pre-occupied with program maintenance rather than new initiatives. Waterton Lakes National Park also experienced major reductions in budget and staff during the first half of the 1990s. At the same time, organizations in the public and private sectors came to realize the importance of 'stakeholder' consultations and 'partnerships' for mutual collaboration in order to achieve what no single organization could do on its own.

4. The core group engaged in biosphere reserve activities carried on with new members under the informal title of "Waterton Biosphere Association" (WBA). It continues to meet about eight times a year, and meetings are open to the community. Over the past five years or so, much of their activity has been participation, by individual members of the association, in stakeholder consultation processes that dealt with conservation and sustainable resource issues in the Waterton or surrounding areas. Not all of these were successful. The WBA is mindful of the nature of its own advocacy role, as well as the question about the balance of time devoted to various "processes" *vis-a-vis* developing "products" that would help demonstrate the value of the biosphere reserve. The WBA has continued to organize or co-sponsor local meetings on topics or issues of concern.

4. In reference to the criteria for biosphere reserves (Article 4 of the Statutory Framework for the World Network of Biosphere Reserves):

[1] The WBR encompasses areas ranging from the mountains to the prairies that are representative of the 'eastern slopes' along a major section of the Rocky Mountains Biogeographic Province. The absence of extensive foothills that occur elsewhere along the eastern slopes makes the area somewhat unique. There is a marked gradation of human interventions in the prairie component of the biosphere reserve (outside of the national park), and in the recreational use of the national park component, ranging from a townsite with the full range of tourism facilities through to backcountry hiking trails.

[2] The steep environmental gradients from the Continental Divide to the prairies has created an unusually rich mosaic of habitats with their associated flora and fauna. The resulting species richness is considerably greater than comparable areas of the Rockies to the north.

[3] Certainly the opportunities are there to explore or demonstrate sustainable resource use practices that are applicable on a regional scale. The WBR has focused mainly upon issues of range management and the reconciliation of wildlife protection with livestock production. Measures to control fire hazards from beetle-killed pine forests have been explored by national park staff. Private sector initiatives are developing ecotourism options that benefit from national parks along the Rocky Mountains, and in ways that can contribute to wildlife conservation, e.g. "Trail of the Great Bear".

[4] The only size limitation of the WBR concerns the maintenance of viable populations of large carnivores. While it contributes to the support of mammals such as grizzly bears, mountain lions and wolverine, the WBR itself is far too small to maintain sufficiently large populations for them to be viable over the long-term. This is also the case with other national parks in the Rockies. This issue is being addressed by initiatives from different agencies and NGOs that place the conservation of large carnivores in the context of "greater ecosystems" such as "The Crown of the Continent", collaboration to develop carnivore conservation strategies for the Rocky Mountains in the United States and Canada (especially for grizzly bears), and a new "from Yellowstone to the Yukon" concept endorsed by some 80 organizations to promote wilderness protection and large animal conservation. These concepts envision a large regional network of protected areas connected by broad habitat corridors managed in ways to reduce negative impacts on the large mammals.

[5] The zonation in the national park management plan identifies the equivalent of core and buffer areas. The 'transition zone' is associated with the cooperative activities carried out with neighbouring

ranchers on the east side of the national park. The more local focus of the WBR should be complemented by a larger regional perspective that takes into account the management of all lands adjacent to the national park. From this perspective, there is an enormous addition to the core function from the adjacent Glacier National Park/Biosphere Reserve in Montana; a modest addition to the core zone from the new Akamina-Kisamina Class 'A' Wilderness Park in British Columbia immediately adjacent to the west boundary of Waterton Lakes National Park; a mix of 'core' and potential 'zone of cooperation' uses in the Castle Mountain area of the Crow-Bow Forest immediately north of the park, and forest management sites along the south-eastern boundary of the Park on the Blood Indian Reserve and at Poll Haven.

The pattern of resource management and use on these adjacent lands reflects a biosphere reserve concept at a much larger scale. The 1992 management plan for the national park recognizes the potential of viewing management issues and the role of the park from this larger perspective as well. The challenge for the next decade is to give this a firmer recognition through appropriate organizational arrangements to foster the degree of collaboration needed to maintain or achieve conservation objectives (e.g. for large carnivores) and sustainable resource use in areas outside of the parks.

[6] The WBA operates informally as a small group of volunteers, with a core of some 6-8 people taking the main initiatives. These individuals also help link WBR concerns to other informal networks of people or organizations devoted to particular conservation or resource use issues. It would be timely to find ways to place the WBA on a more formal base as a legal non-profit society that could help 'catalyze' activities among these various networks.

[7] The extent of the 'buffer zone' is somewhat undefined for the WBR. The national park and all lands adjacent to it are administered under different policies and plans for land or resource use, by different jurisdictions, i.e. federal, provincial and municipal. While administered separately, there are some informal provisions for consultations, mainly on an *ad hoc* basis as the need arises.

Programs for research, monitoring, education and training are underway within the WBR. There is regular cooperation between the two national parks, Glacier and Waterton (which have been designated as an International Peace Park since 1932), to provide interpretive services for visitors. While there is recognition of the desirability for closer cooperation among land management agencies there are problems in obtaining the financial resources to do more than routine maintenance of existing programs.

5. Compared to the current ideals for a fully-functioning biosphere reserve, the Waterton Biosphere Reserve has all of the components in place, and over the years has engaged in activities that contributed to all the main functions of a biosphere reserve. The main difficulty has been the lack of resources to evolve

from a dedicated volunteer group to a small, but effective 'catalytic organization' with a broader membership base, a corporate identity, and a small staff to organize and coordinate projects and programs. At the same time, the biosphere reserve concept may be emerging as a functional reality at a much larger scale. In addition, the possibility of a single international biosphere reserve on the scale of the Glacier-Waterton mountain complex has been raised again, this time on the occasion of the World Heritage Designation for the two parks in 1995.

6. The reviewer believes that the Waterton Biosphere Reserve certainly merits continued membership in the World Network of Biosphere Reserves. Except for the extent of formal organization, it fulfills the Article 4 criteria. Despite the difficulties the WBA group has faced in getting funding and other support, they are very positive about the future. They recognize the critical role that a small, but effective organization can play within the larger overlay of institutional arrangements for conservation and sustainable resource use, such as those exhibited at the Crown of the Continent scale in the Rocky Mountains. Their challenge is impressive, but so is their commitment to deal with it.

## **II. Background and Overview**

The Waterton Lakes National Park in Alberta is immediately adjacent to Glacier National Park in Montana. As integral components of the same Rocky Mountain complex, but divided by the international boundary between Canada and the United States, the two parks were designated as an International Peace Park in 1932. In 1976, Glacier National Park was nominated as a biosphere reserve. Canada nominated Waterton Lakes National Park in 1979, after the first management plan for the park was completed in 1978. Following some consultations with Canada/MAB, an organizing meeting was held in April 1981, to which local people from the neighbouring communities to the east of Waterton were invited. A small

biosphere reserve group was then formed, and the three main topics identified for it to pursue were relations between the park and ranchers immediately east of the park, opportunities for collaborative research, and information dissemination. While unanticipated at the time, these topics have remained as a recurring theme for the biosphere reserve.

The Waterton biosphere reserve group receives \$5,000 per year from Parks Canada (the federal national parks agency) to help cover various expenses. Funding over and above this has to be solicited from other sources. Members of the group volunteer their time. Except for a brief period in 1990-1991, when the group had a part-time Executive Director (for one day a week) there have been no staff specifically for the biosphere reserve. However, the biosphere reserve does draw upon staff from other organizations for particular activities initiated through, or assisted by volunteers for the biosphere reserve.

Soon after it was formed, the local biosphere group organized itself into a management or steering committee with about five representatives from the national park, private ranch owners, and persons from the local community. By 'tradition', a rancher continues to serve as the Chair. The management committee created a technical advisory committee in 1983 with representatives from several federal and provincial agencies and contacts with the oil and gas industry to advise and assist the management committee with research and monitoring projects. The initial focus was on issues concerning wildlife, cattle and rangeland management. The management committee met about eight times a year, and the technical committee once or twice a year.

By the late 1980s, the biosphere reserve group had a number of collaborative research and associated public information activities underway. The main ones were to study elk-livestock range interactions (including habitat preferences and composition of diets); consider options for the management of the Waterton elk herd (through revisions in hunting regulations outside of the park); assess the health of the elk herd (to address concerns about possible disease transmission to cattle); test the establishment and productivity of seeded forages (26 grasses and legumes); assist with soil surveys in south-western Alberta; map vegetation communities in the zone of cooperation; conduct ecological studies of aspen; explore methods for brush control on rangelands; and test different bear 'repellents' to reduce bear/people conflicts.

Along with the research, the biosphere reserve sponsored public seminars on topics such as: forestry research in the area; the outbreaks of mountain pine bark beetle in and around the park; reporting on the first international conference on biosphere reserves (held at Minsk, Belarus, in the former USSR, in 1983), and grazing lease conversion policies. Public forums were sponsored on topical issues such as elk and ranchlands, and the control of spotted knapweed. An educational sub-committee was established in 1985 to promote closer contacts with school and community groups and the biosphere reserve committee

obtained funding for public awareness and information activities from the TransAlta Utilities Corporation. The management committee adopted revised terms of reference in 1986. The technical committee, in 1986, laid out a research program with priorities for addressing issues of ecological land classification, the impacts of non-renewable resource extraction (oil and gas) on the biosphere reserve, fire ecology, and elk-livestock range interactions.

By 1989, the management committee had decided to form a Waterton Biosphere Association (WBA) -- they dropped 'Reserve' because of negative connotations many people associate with the term -- and drew up a charter for incorporation as a non-profit society under Alberta legislation. Over a 2-3 year period from about 1989, several of the key founding members of the group who had provided leadership for the biosphere reserve moved away from the Waterton area. The level of activities subsequently declined, at least until about 1993 when new people (including new park staff and other ranchers) volunteered time and expertise to the biosphere reserve. The 'new' WBA did not proceed with incorporation as a non-profit society (for reasons not clear from the record). The WBA functions as a single committee of about 6-8 people who meet about eight times a year.

By the early 1990s, the context in which the WBA worked had changed significantly. Both federal and provincial government agencies were experiencing budget and staff reductions. Waterton Lakes National Park, for example, had its budget reduced by about 40% and its staff complement by about one-half from 1990 to 1995. This general 'downsizing' in government reduced the funding available for research, especially on topics that may be of interest to non-governmental organizations or community groups, but outside the core mandate of administrative agencies. The WBA continued to offer informal help with research that individuals from government or universities proposed, but often the projects were cancelled because their proponents did not receive the expected funding. Agency staff also became pre-occupied with program maintenance rather than new initiatives.

At the same time, government agencies became more acutely aware of the need for cooperation and 'partnerships' to carry out functions which no one organization could do on its own. One result was that the WBA, often on the basis of initiatives by individual members, became much more involved with stakeholder consultation processes that dealt with conservation or resource use issues in the Waterton or surrounding areas. In recent years, these have included "The Crown of the Continent Ecosystem" initiative to promote protection, recognition and land use coordination over mountain areas in Alberta, British Columbia and Montana, ranging from the Bob Marshall Wilderness area south of Glacier National Park in Montana through to Banff National Park in Alberta; a follow-up project to create a "Crown of the Continent Electronic Data Atlas"; consultations over a major four seasons resort complex proposed in 1990 for the West Castle area north of the national park; participation in the Waterton Lakes National Park

Advisory Board from 1994; participation in a Shell Canada Resources 'round table' process to address questions in the zone of cooperation concerning natural gas processing and re-vegetation of abandoned oil sites with native plants; participation in a multi-stakeholder Prairie Conservation Action Plan, and consultations to develop an Ecosystem Management Framework Agreement among agencies, following a 1995 workshop on this subject convened at Waterton.

These collaborative processes were not always successful, which can lead to a feeling of time wasted, or lack of appreciation for genuine commitment to the dispute resolution processes inherent in some of the consultation processes. All along, the WBA had to be mindful of the manner in which it engaged, or was perceived in the community to engage in advocacy, i.e. it advocates conservation and sustainable resource use generally, but this implies opposition to 'development' schemes that undermine either or both.

The WBA continues the informal information dissemination role by giving regular talks to local groups, arranging field trips for students, organizing public meetings to discuss issues which arise, e.g. "cows and fish", an initiative to protect fish habitat in streams flowing through ranchlands; the "Belly River Wolf Pack" to provide information about a family of timber wolves that denned in the park close to the ranchlands; "Land Conservancy in the Zone of Cooperation"; and the biological control of spotted knapweed (*Centaurea maculosa*). It sponsored or co-sponsored workshops or conferences (e.g., the "Waterton-Glacier International Writers' Workshops", and conferences on ecosystem management issues). The WBA also arranged for high school students to become involved in a new SI/MAB forest trees biodiversity monitoring plot.

Thus, over the past several years the WBA has been kept quite busy, but has little documentation (or 'paper trail') to show this. The group has periodic concerns about the time spent on 'process' which may be at the expense of 'products' that could be used to demonstrate the value of a biosphere reserve. Local support and interest in the biosphere reserve varies according to the issues it addresses, and the WBA periodically examines questions about how their time might best be spent.

The WBA has also taken up issues that require consideration at a larger regional scale than did some of the earlier problems they addressed on neighbouring ranchlands. Conservation issues have become focused, both functionally and symbolically, on the conservation of viable populations of carnivores, something that could only be achieved through collaboration among government agencies responsible for parks and resource management, and various private landowners and interest groups over large areas of the Rocky Mountains. This is expressed in the "Crown of the Continent" concept which recognized the need to consider lands on both sides of the Continental Divide extending from the Northern United States through

southern Canada. The grizzly bear has come to symbolize conservation that has to be addressed on this larger regional scale.

A number of resource management issues are also best viewed from the larger regional scale. Pressures to convert ranch lands into residential or recreational uses adjacent to the park are among the more immediate perceived threats to a viable ranching economy. Besides the effects on land prices, such developments could disrupt the panoramic viewscapes that are so much a part of the appeal of the Waterton area. Yet, these pressures are occurring along much of the 'front range' of the Rockies in both the US and Canada. Outside of the national park, areas of lower elevation adjacent to the mountains are subject to oil and gas exploration, logging, livestock grazing, hunting, and motorized recreational activities, all of which can disrupt wildlife through habitat fragmentation and an increase in direct mortality. These are among the perceived stresses on populations of the large carnivores.

In looking to the future, the WBA recognizes it will have to address the following issues:

1. The suggestion from the World Heritage Committee that a single international biosphere reserve be created from the three existing ones in the Glacier-Waterton World Heritage Site, i.e. Glacier National Park, the Coram Forest Experimental Station, and the WBR, to reflect the scale of the world heritage designation. This issue has come up before. In 1984, the former management committee agreed to help nominate a "Rocky Mountains International Biosphere Reserve", but after considering the logistics further it decided not to do this because there was too much to do locally. The logistics would have to be worked out by the three 'lead agencies' involved, but it also raises questions about a biosphere reserve program in this new and larger context. The single larger biosphere reserve might seek to become the research, monitoring and educational 'arm' for the world heritage site. But it would have to operate in a decentralized manner so that local and community issues of conservation and sustainable resource use can be addressed directly. From this perspective, the WBA might be a 'prototype' for similar 'grassroots' initiatives elsewhere within the larger region.

2. Strengthened capabilities to take on tasks, especially if they are to be set in the larger regional context. This would seem to imply a need for formal incorporation of the WBA as a non-profit society, and a wider membership base, sufficient to support staff services for the WBA. The aim would be to develop a small but effective 'catalytic' organization that could work through different informal networks of cooperation to help achieve the functions of a biosphere reserve. Part of that function could be to help realize the larger scale biosphere reserve that seems to be evolving when viewed from the perspective of all the resource management units adjacent to Waterton Lakes National Park.

3. Extension of ecosystem monitoring arrangements beyond the national park 'core' to include the rest of the WBR, and linking up where possible with monitoring in other adjacent lands. The new ecosystem monitoring program being designed for Waterton Lakes National Park could, if extended through selective arrangements for monitoring outside of the park, provide the basis for comparison between 'benchmark' sites in the park and comparable managed sites outside of it. A number of range or forest management questions might be the initial ones on which to proceed. With the new involvement of the WBR in the Canadian "Ecological Monitoring and Assessment Network" (EMAN) as a member of the "Montane Cordillera Ecological Science Cooperative" and the "Prairies Ecological Science Cooperative" there will be opportunities for cooperation with other long-term ecological monitoring and research sites which are concerned with the 'what and why' of environmental change.

### **III. PERIODIC REVIEW FORM FOR BIOSPHERE RESERVES**

#### **I. NAME OF THE BIOSPHERE RESERVE**

**Waterton Biosphere Reserve**

#### **II. COUNTRY**

**Canada**

#### **III. PHYSICAL CHARACTERISTICS OF THE BIOSPHERE RESERVE**

##### **Latitude and Longitude**

49° 00' - 49° 12' North    113° 39' - 114° 10' West

*Please enclose a map showing the general location of the biosphere reserve.*

[See Figure 1]

##### **Biogeographical Region**

*Indicate the name usually given to the biogeographical region in which the biosphere reserve is located.*

### 1.19.12 Rocky Mountains

Under the Canadian ecological land classification scheme, the biosphere reserve is in the Montane Cordillera Ecozone, and Northern Continental Ecoregion (No. 236), and the Prairie Ecozone, Fescue Grassland Ecoregion (No. 179).

*The enclosed map has been prepared on the basis of information available at the Secretariat. Indicate if the biosphere reserve is correctly sited and whether it lies within the appropriate ecosystem type.*

[Not applicable]

### **Topography of the region**

*Briefly describe the major topographic features (wetlands, marshes, mountain ranges, dunes, landscapes, etc...).*

Waterton Biosphere Reserve (WBR) encompasses a section of the east slopes of the Rocky Mountains extending from the Continental Divide to the edge of the prairie plains to the east. The Divide, which is sometimes called the "Crown of the Continent", separates the watersheds flowing west to the Pacific Ocean, south and east to the Atlantic Ocean, and north and east to Hudson Bay, or the Arctic Ocean. In the absence of extensive foothill formations, this topography provides a dramatic panorama "where the mountains abruptly meet the prairie". The steep environmental gradients have produced a rich diversity of habitats including mountain peaks and alpine meadows; montane spruce, fir and pine forests; lakes, streams, and waterfalls; native prairie and ranchlands; and lower elevation wetlands.

Highest elevation above sea level (metres): 2,920 (Mt. Blakiston)

Lowest elevation above sea level (metres): 1,280 (at the Waterton National Park boundary)

Outside the park to the north and east, the elevation drops over a 50 km distance to about 1,155 m.

### **Climate**

*Briefly describe the climate of the area using one of the common climate classifications.*

The Waterton Biosphere reserve embraces two quite different ecoclimatic regions in Canada: the Boreal Southern Cordilleran (SCb) and Subhumid Grassland (Gs) Ecoclimatic Regions (Ecoclimatic Regions of Canada, 1989). SCb is characteristically rainy and cool during the summer with from 50-100 frost free days. Gs experiences warm and dry summers with a significant late summer moisture deficit that causes most plants to become dormant. Winters are cold, but moderated with frequent "chinook" winds that ameliorate temperatures and reduce snow cover. Winds are predominantly from the south-west and can reach gale force velocities in mountain valleys at any time of the year.

Local weather is influenced by two opposing air mass systems, the Pacific Maritime and the Arctic Continental. The "chinook" winds during the winter come from warmer Pacific air masses breaking through colder Arctic air masses. The average temperature of the coldest month reflects this phenomenon of relatively warm winds interspersed with bitter cold weather. Waterton has the highest frequency of "chinooks" in Alberta, an average 28 days during winter when the temperature is 2.5° C or above.

Average temperature of the warmest month: 15.3° C

Average temperature of the coldest month: -4.6° C

Mean annual precipitation: 873.6 mm (about one half as snow) recorded at an elevation of 1280 m

Data are from the Waterton River Cabin meteorological station located at 49° 7' N, 113° 51' W. Precipitation data used to calculate these averages were gathered over a 21-24 year period, and temperature data over a 4-8 year period. There are currently three meteorological stations in the WBR. Besides the one near the Waterton townsite, there is a station in the spruce-fir forests near the Akamina Pass and another on the prairie close to the eastern park boundary. Both of these stations are associated with biodiversity monitoring plots (See Section VI).

### **Geology, geomorphology, soils**

*Briefly describe the main land formations and characteristics.*

The WBR is underlain by folded and faulted sedimentary rocks that were compressed and shifted horizontally some 80 million years Before Present (BP) to form a complex mountain system of low angle

thrust faults, the "Lewis Thrust". The Lewis Thrust forced older Proterozoic (Precambrian) rocks dating back some 2.5 billion to 570 million years (BP) over Mesozoic (Upper Cretaceous) formations dating from 245 million to 60 million years BP. West of the Lewis Thrust, the mountains are composed of Proterozoic bedrock, and east of the Thrust, under foothills and the plains, the bedrock is Mesozoic. The Proterozoic rocks consist of various formations of argillites, quartzites, dolomites, limestones, and basalt. The Mesozoic rocks are mainly textured shales.

Since that time, the geomorphological features of the WBR have been moulded by fluvial and glacial erosion. Cordilleran glaciers have advanced down the valleys from their origins in mountains on a number of occasions over the past two million years, and a continental ice sheet spread across the Great Plains region during the Wisconsinan glaciation era some 70,000 - 50,000 years BP. The resulting landform variations are associated with different mixes of parent materials and the physical processes by which they were mixed and distributed over lower elevations.

The dominant soils in the SCb ecoclimatic zone are gray luvisols and brunisols underlying conifer forests. Soils in the Gs ecoclimatic zone are black chernozems or dark brown chernozems underlying the grasslands. Seven of the nine orders of the Canadian System of Soil Classification occur in the WBR. In addition to the above soil orders, podzolic soils underlay the more humid subalpine forests, regosolic soils are found in sites subject to natural disturbances, and gleysolic and/or organic soils occur in water-logged areas.

### **Significance for conservation of biological diversity: habitats and characteristic species**

*List main habitat types (e.g. humid tropical forest, savanna woodland, alpine tundra, coral reef, seagrass beds) and land cover (e.g. residential areas, agricultural land, grazing land).*

A detailed Ecological Land Classification study at the scale of 1:20,000 was completed for Waterton Lakes National Park in 1997 [Achuff, McNeil and Coleman 1997]. It defined four ecoregions, 25 ecosections and 83 ecosites, based on vegetation, soils and drainage classes. Some 45 vegetation types were distinguished for this study. The ecoregions are noted below (in place of "Types of Habitat" on the periodic review form).

[a] Alpine Ecoregion: Much of this ecoregion consists of rock outcrops, talus, and colluvial rubble. Areas above 2,250 m altitude are treeless. Alpine vegetation occurs in fine-scale mosaics associated with the microclimatic effects of wind exposures, aspect, snow depths, snow melt, and soil moisture.

Main species: Predominant vegetation types are *Dryas octopetala* (mountain avens); *Polemonium viscosum* - *Saxifraga spp.* (skunkweed - saxifrage); and saxicolous lichen tundra.

Main human impacts: None.

Relevant habitat management practices: None needed.

[b] Subalpine Ecoregion: This ecoregion occurs at elevations between 1,680 m and 2,250 m, and can be sub-divided into upper and lower subalpine at an elevation of 1,950 m. Upper subalpine areas have open forest with stunted trees (krummholz) and avalanched shrub communities. Lower subalpine has closed coniferous forests, younger post-fire pine forests, and shrub communities on avalanche sites.

Main species: Upper subalpine forests include *Larix lyalli* with *Luzula hitchcockii* (subalpine larch with smooth woodrush), *Picea engelmannii* and *Abies lasiocarpa* with *Luzula hitchcockii* and herbs (Engelmann spruce and subalpine fir with smooth woodrush and herb), *Pinus albicaulis* and *Abies lasiocarpa* with *Luzula hitchcockii* and *Vaccinium myrtillus* (whitebark pine and subalpine fir with smooth woodrush and low bilberry) and *Pinus albicaulis* and *Picea engelmannii* with *Dryas octopetala* (whitebark pine and Engelmann spruce with mountain avens). Avalanched shrub communities include *Abies lasiocarpa* with *Arnica cordifolia* (subalpine fir with heart-leaved arnica, and lush herb meadows such as *Senecio triangularis* and *Erigeron peregrinus* (arrowleaf ragwort and fleabane).

Lower subalpine areas have older forests dominated by Engelmann spruce and subalpine fir. Typical vegetation types include *Picea engelmannii*, *Abies lasiocarpa* and *Pseudotsuga menziesii* with *Arnica cordifolia* (Engelmann spruce, subalpine fir and Douglas fir with heart-leaved arnica); *Picea engelmannii*, *Abies lasiocarpa* and *Pinus contorta* with *Menziesia ferruginea*, *Arnica cordifolia* and *Rubus parviflorus* (Engelmann spruce, subalpine fir and lodgepole pine with false azalea, heart-leaved arnica and thimbleberry); and *Picea engelmannii* and *Abies lasiocarpa* with *Menziesia ferruginea* and ferns (Engelmann spruce and subalpine fir with false azalea and ferns. On post-fire areas, vegetation types include *Pinus contorta* with *Arnica cordifolia* and *Spirea betulifolia* (lodgepole pine with heart-leaved arnica and white spirea), and *Pinus contorta* with *Vaccinium myrtillus* (lodgepole pine with low bilberry). Avalanched areas include *Alnus crispa* with ferns (green alder with ferns); *Populus tremuloides* with *Amelanchier alnifolia* (aspen with saskatoon berry); *Abies lasiocarpa* with *Menziesia ferruginea* and *Xerophyllum tenax* (subalpine fir with false azalea and bearberry); and *Abies lasiocarpa* with *arnica cordifolia* (subalpine fir with heart-leaved arnica. On wind-exposed sites, *Potentilla fruticosa* and forbs (shrubby cinquefoil and forbs) occur.

Main human impacts: None

Relevant habitat management practices: None needed.

[c] Montaine Ecoregion: This ecoregion occurs at altitudes of 1,200-1,680 m and is characterized by both open and closed coniferous forests dominated by Douglas fir and limber pine.

Main species: Typical vegetation types include *Pseudotsuga menziesii*, *Pinus flexilis* and *Pinus contorta* with *Arctostaphylos uva-ursi* and *Juniperus communis* (Douglas fir, limber pine and lodgepole pine with bearberry and common juniper); *Pseudotsuga menziesii* and *Pinus contorta* with *Arctostaphylos uva-ursi* and *Festuca scabrella* (Douglas fir and lodgepole pine with bearberry and rough fescue); *Pinus flexilis* with *Arctostaphylos uva-ursi* (limber pine with bearberry); and *Pseudotsuga menziesii* with *Rubus parviflorus*, *Thalictrum occidentale* and *Arnica cordifolia* (Douglas fir with thimbleberry, western meadowrue and heart-leaved arnica). Lodgepole pine forests occur in the upper portions of the montane ecoregion, but many trees were killed in an outbreak of mountain pine bark beetles in the 1980s. Vegetation types include *Pinus contorta* with *Arnica cordifolia* and *Spirea betulifolia* (lodgepole pine with heart-leaved arnica and white spirea); and *Pinus contorta* with *Calamagrostis rubescens* and *Aster conspicuus* (lodgepole pine with pine grass and showy aster). Grassland associations occur on dry, exposed sites, including *Danthonia spp.*, *Festuca scabrella* and *Koeleria macranthus* (oatgrass, rough fescue and June grass); *Agropyron spicatum* and *Festuca scabrella* (bluebunch wheatgrass and rough fescue); and *Festuca scabrella* and *Arctostaphylos uva-ursi* (rough fescue and bearberry).

Main human impacts: Recreational use

Relevant habitat management practices: Controlled/restricted access.

[d] Foothills Parkland Ecoregion: This ecoregion is characterised by a landscape of rough fescue grassland and aspen grove forests which occupy a narrow band along the eastern edge of the foothills of the Rocky Mountains. The altitudinal range of this ecoregion in the WBR is about 1,200-1,500 m.

Main species: Typical grassland vegetation types include *Danthonia spp.*, *Festuca scabrella* and *Koeleria macranthus* (oatgrass, rough fescue and June grass); and *Agropyron spicatum* and *Festuca scabrella* (bluebunch wheatgrass and rough fescue). The aspen grove portion includes *Populus tremuloides* with *Amelanchier alnifolia* and *Heracleum lanatum* (aspen with saskatoon berry and cow parsnip); *Populus tremuloides* with *Symphoricarpos occidentalis* (aspen with western snowberry); and on moister sites

*Populus tremuloides* with *Rubus parviflorus* (aspen with thimbleberry). Disturbed, heavily-grazed portions are often a combination of *Populus tremuloides* with *Urtica dioica* (aspen with nettle) and *Bromus inermis* and *Phleum pratense* (smooth brome and timothy).

Main human impacts: Recreational use inside the national park, and livestock ranching in the zone of cooperation.

Relevant habitat management practices: Controlled/restricted access inside the national park. Lands outside of the park are used for livestock grazing, including forage production (hay) for winter feeding.

#### Conservation Value

The moist Pacific Maritime weather system is sufficiently persistent to have resulted in the spread of flora and fauna commonly associated with the Pacific Northwest into the WBR resulting in assemblages not found elsewhere farther north or south in the Rockies. Elements of the prairie biota also occur to help generate considerable species richness. Some 971 species of vascular plants and 300 species of vertebrate animals occur in the WBR.

#### Habitats of special interest:

*Describe and indicate location of habitats which are unique or exceptionally important from the point of view of conservation.*

The Ecological Land Classification for the national park identified 11 ecosites that contain rare combinations of landforms, soil and vegetation, in three of the four main ecoregions. In addition, habitats of special interest include the fescue grasslands, patches of aspen parklands in a narrow north-south band along the Foothills Parkland Ecoregion, and riparian forests of black cottonwood (*Populus trichocarpa*) and willows (*Salix spp.*) along the streambanks of rivers flowing north and east through the rangelands.

The grasslands and aspen parklands provide critical winter range for ungulates, and early spring foraging areas for bears. Wetlands in this area are also important stop-over sites for migrating waterfowl, including Trumpeter swans (*Cygnus buccinator*). The riparian corridors, ridge systems, and the mountains form important connections that link mosaics of different habitats along different gradients which is important for conservation at a regional level.

Endangered or threatened plant and animal species:

*Identify species (with scientific names) or groups of species of particular interest for conservation, in particular if they are threatened with extinction.*

Plants: The WBR has one endemic plant, *Botrychium x watertonense* (Waterton moonwort); three species that occur in Canada only in the WBR, *Agropyron x brevifolium*, *Botrychium paradoxum*, *Erigeron lackschewitzii*; 22 species that occur in Alberta only in the WBR, and another 28 that are deemed rare or threatened elsewhere in Alberta. Of the 971 currently recorded species of vascular plants in the WBR, 179 species are rare in Alberta [Achuff 1997].

Animals: Grizzly bear (*Ursus arctos*), Wolverine (*Gulo gulo*), and trumpeter swan (*Cygnus buccinator*) are listed as vulnerable by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Mountain lion (*Felis concolor*), Lynx (*Lynx canadensis*), greater sandhill crane (*Grus canadensis*), and bull trout (*Salvelinus confluentus*) are potentially vulnerable in Alberta.

Species of traditional or commercial importance:

*Indicate the uses(s) of these species or varieties.*

Until their extermination in the Waterton region by 1879, herds of buffalo (*Bison bison*) had been of crucial economic and cultural importance to the aboriginal peoples of "The Blackfoot Confederacy", including the Blood and Peigan 'First Nations' living in or around what is now the national park. Aboriginals also hunted elk (wapiti) (*Cervus canadensis*), deer (*Odocoileus* spp.), and occasionally mountain sheep (*Ovis canadensis*) and goats (*Oreamnos americanus*), and they fished seasonally. Some 40 species of plants were used for food, medicines, cosmetics, and ceremonial materials.

At the present time, outside of the national park, local people continue to hunt elk, deer, ducks, geese, and grouse. Bears may be killed whenever they become a 'nuisance' (although only black bears *Ursus americanus* may be killed legally), as may coyotes (*Canis latrans*) and wolves (*Canis lupus*). Trout fishing remains popular. Small numbers of buffalo are kept on some ranches for the production and sale of meat and hides, and a commercial elk ranch is planned for a site within the zone of cooperation of the WBR. Forests in several areas adjacent to the national park are harvested commercially.

#### **IV. ZONATION**

## Names of the difference areas

*Indicate the names of the different areas which make up the core area(s) and buffer zone(s).*

The nomination application in 1979 noted the five different zones designated in the first management plan for Waterton Lakes National Park, in 1978. It implied that the entire park was to be a 'core' for the proposed biosphere reserve. When the first biosphere reserve committee was organized in 1981, Canada/MAB suggested that the park zones conformed to the core and buffer zones of a biosphere reserve. The reasoning was that the small portions of the park which had 'motorized access' served to concentrate most of the visitor use, and could be perceived as a 'buffer' that helped protect the 'primitive access' and 'non-motorized access' zones that constituted most of the park.

The main task of the new committee was to determine how best to relate to the owners of private ranchlands immediately east of the national park. This area would constitute some kind of a 'transition zone', or as the Waterton committee preferred, a 'zone of cooperation' that had to be developed to help address some common issues faced there by ranchers and park staff. No boundaries were drawn on a map to depict this zone of cooperation because the spatial extent had yet to be determined by the kinds of cooperation that would evolve. Of greater concern, however, was the knowledge that any line drawn on a map extending beyond park boundaries would raise immediate suspicions among landowners about the intent of the government. This would have undermined any possibility of gaining the trust and voluntary cooperation of landowners 'inside' such a line.

The situation remains the same in 1997. The 1992 Waterton National Park Management Plan has modified the zoning classification for the park, but the park is still viewed as the core area for the biosphere reserve. Over the years, it has been ranchers living relatively nearby the park boundary who have become involved with the WBR. The 'active' zone of cooperation is now perceived to be within an area extending north to the hamlet of Twin Butte, and east to the hamlet of Mountain View, both about 20 km from the national park. With these slight modifications the WBR is approximately as follows.

## Spatial configuration

*A BIOSPHERE RESERVE ZONATION MAP of a relatively large scale (1:25,000 or 1:50,000) showing the delimitations of all core area(s) and buffer zone(s) must be provided. Also indicate the approximate extent of the transition area(s).*

Size of the terrestrial Core Area(s): 46,285 ha.

Size of the terrestrial Buffer Zone(s): 6,312 ha.

Approximate size of terrestrial Transition Area(s)  
(if applicable) [See note below]

*Brief justification of this zonation (in terms of the various roles of biosphere reserves) as it appears on the zonation map.*

Please refer to the 1:50,000 map of Waterton Lakes National Park (Annex 1) and to the 1992 Waterton Lakes National Park Management Plan (Annex 2), especially pp. 16-19 on zonation. The 'core area' is deemed to be represented by the Special Preservation, Wilderness and Natural Environmental Zones of the national park, and the 'buffer zone' by the Outdoor Recreation Zone. The current 'transition area'/zone of cooperation extends to selected sites in ranchlands adjacent to the park, but only a minority of ranchers who live in this ranching area participate in the WBR. Other ranchers are reported to be philosophically opposed to "park values". The "Blood Indian Reserve" immediately adjacent to the national park is being managed for traditional uses of the forest by local indigenous people.

From a larger regional perspective, and considering policies and plans for all lands adjacent to the national park, a biosphere reserve concept may be evolving at that scale. See Section VIII concerning management policies and plans. However, it is too premature to propose this as a functional reality. Instead, this may be a goal to pursue over the next decade. [See Figure 2]

## V. HUMAN ACTIVITIES

### **Population living in the reserve**

Approximate number of people living within the Biosphere Reserve.

Waterton has a permanent population of 279 (1996 census data), and a seasonal population of about 2,250 during the summer peak season.

*Brief description of local communities living within or near the Biosphere Reserve.*

The hamlet of Mountain View (1996 population: 64) in the Municipal District of Cardston, and the hamlet of Twin Butte (1996 population: 16) in the Municipal District of Pincher Creek represent the approximate extent of the 'influence' of the WBR in the ranching area east of the national park.

*Indicate ethnic origin and composition, minorities etc., their main economic activities (e.g. pastoralism) and the location of their main areas of concentration, with reference to a map if appropriate.*

Descendants of the aboriginal 'First Nations' live in the two municipal districts adjacent to the national park, and a small "Blood Indian Reserve" is immediately adjacent to the south-western boundary of the park. The Municipal District of Cardston was settled mainly by Mormons from the western United States. The Municipality of Pincher Creek was settled by people of British, French or other European descent who came either from eastern Canada, the United States, or directly from Europe. Two Hutterite colonies of German ethnic origin, organized as tightly-knit agriculturally-based religious communities, are also in the area.

*Name(s) of nearest major town(s).*

Pincher Creek (1996 population: 3,659), Municipal District of Pincher Creek, and Cardston (1996 population: 3,417), Municipal District of Cardston.

### **Cultural significance of the site**

*Briefly describe the Biosphere Reserve's importance in terms of cultural values (religious, historical, political, social, ethnological).*

The WBR has about 250 known archaeological sites, some of which date back ~11,000 years BP. Evidence from the 'early prehistoric period' (~10,000 to 7,500 years BP) and 'middle prehistoric period' (7,500 to 1,600 years BP) indicated two cultural traditions, one which relied heavily on buffalo hunts on the plains, and the other which had a more diversified hunting, fishing, and gathering economy adapted to mountain environments. The "Napikwan" peoples developed bows and arrows at some point after ~1,800 years BP for use in buffalo hunts. There is also evidence of a major "buffalo jump" (where the animals were stampeded off cliffs) in the WBR which was used by the "Tunaxa" peoples during the middle historic period.

The 'late prehistoric period' (from 1,600 to 200 years BP) was characterized by a number of different cultural complexes and settlement patterns. The WBR was occupied seasonally by Kutenai Indians from west of the Continental Divide, who were also the first to acquire horses (from the Shoshoni between the years 1725-1800). This altered both hunting and war patterns with people in "The Blackfoot Confederacy" who claimed the territory immediately east of the Rockies.

The European influence began with fur traders in the early 1800s. It was subsequently followed by land surveyors, settlers and the extension of military and political control over the territory by the latter part of the 19th century. This was at the expense of the native people who were forced out of traditional hunting (with the near extermination of buffalo, by 1879 in the Waterton area) and on to 'Indian Reserves' to adjust to agriculture and the dominant Euro-Canadian society.

Cultural values now are associated with the access to wilderness, scenery, eco-tourism, and wildlife viewing that can be obtained in the WBR and neighbouring areas along the Rockies. The concept of the 'Crown of the Continent' (a region that straddles the Continental Divide between Banff National Park in Alberta and just south of Glacier National Park in Montana) has captured considerable support among various organizations to promote the collaboration needed to conserve mountain wilderness and the large carnivores, symbolized best by grizzly bears. The most recent expression of this is the concept "from Yellowstone to the Yukon (Y2Y)" endorsed by some 80 organizations to encompass these values for the entire Rocky Mountain chain.

### **Use of resources by local populations**

Uses or activities in the Core Area: Tourism, natural heritage values.

Main land uses and economic activities in the Buffer Zone: Tourism.

Main land uses and major economic activities in the Transition Area: Agriculture, especially livestock ranching. Indigenous cultural/spiritual values and sustainable forest use within the "Blood Indian Reserve".

Possible adverse effects of uses or activities in the transition area(s) and remedial measures taken:

From a conservation perspective, a landscape where the human impact is very diffuse, such as on ranch lands, is preferable to the concentrated impacts brought about by residential and some recreational uses. Thus, there is growing concern about a growing market for residential and recreational properties on

ranch lands adjacent to the national park, It has generated controversy between landowners who wish to sell property, ranchers who want to protect the livestock economy from rising land prices, and various groups who want to maintain the aesthetic values of the panoramic viewscape of mountains and plains without disruptions from ill-planned 'development'.

This is considered locally to be the most critical issue facing the WBR and other areas along the eastern front of the Rockies. The only remedial measures available are to oppose applications for 'development' at meetings of municipal councils which have to approve them. This has been going on for the past decade, but new applications keep coming up on a regular basis. There is some interest among some ranchers in forming a Land Trust that might protect ranch lands from development.

If known, give a brief summary of past/historical land uses(s) of the main parts of the Biosphere Reserve:

Besides early visits to the area from fur traders, other early travellers to the WBR area came from the Palliser Expedition in 1857-1860 which was sent to do reconnaissance surveys in the Canadian plains along the US border, and from joint British-American survey parties to establish the international boundary along the 49th parallel in 1858-1861. A North West Mounted Police (NWMP) expedition in 1874 eliminated a thriving whiskey trade that was particularly destructive to the native population, and established quarters at Fort MacLeod. The NWMP established a horse ranch at Pincher Creek around 1875, and land surveyors laid out possible settlements during the 1880s. Former members of the NWMP were among the early settlers in the area.

In 1895, a 13,991 ha "Kootenay Forest Park" was established in what is now the WBR. This was reduced to 3,368 ha in 1911 and re-designated as "Waterton Lakes Dominion Park". In 1914 the park was enlarged to over 109,500 ha by including a large area of mountains north of the original park. In 1921, much of this was removed again from the park, which was then reduced to 57,000 ha. Between 1947-1954, small reductions were made which brought the park to its present size. Deciding upon the appropriate management policies for lands in the mountains and foothills north of the national park remains controversial to this day (See Section XIII).

In 1891 oil seepages were discovered within part of the present-day national park. This led to attempts at commercial exploitation between 1901-1907, which were not very successful at the time. Subsequently, the Shell-Waterton sour gas field has been developed in the zone of cooperation and beyond which provides significant employment and local tax revenues for the region. There were also some

sawmills in the area during the early 1900s. Three small mines for gold, silver, and copper were operated under the 'forest park' designation, but were closed down when the national park was established.

## **Tourism**

*If tourism is a major activity, how many visitors come to the Biosphere Reserve each year?*

Visitation to the Waterton Lakes National Park has fluctuated slightly around an average 350,000 people per year from 1989-1994. The park has 283 km of trails. Designated backcountry camp sites are used by ~2,000 overnight visitors per year, and backcountry day-use involves ~27,600 people per year.

National: 56%, mainly from SW Alberta

Foreign: 44%, mainly from nearby US locations.

*Type(s) of touristic activities (study of fauna and flora, recreation, camping, hiking, sailing, horseriding, fishing, hunting...).*

The national park has characterized groups of tourists as follows:

- \* Sightseer groups: driving, boat tours, cycling, walking;
- \* Heritage appreciation groups: naturalists, youth camps, research;
- \* Backcountry enthusiasts: hikers/campers, horse riding, ski tours;
- \* Leisure groups: picnics, canoes, fishing, commercial trail rides;
- \* Challenger seekers: climbing, kayaking;
- \* Sports enthusiasts: motor boats, sailing, golfing, skiing; and
- \* Package tours: bus tours, conferences, group camping.

Hunting for elk and deer is done during the fall and winter in areas adjacent to the national park. Commercial tour operators are also offering regional package tours in which Waterton is but one stop.

*Tourist facilities and description of where these are located.*

Waterton townsite has a total of 290 hotel rooms in six different lodges as well as a range of restaurants, shops, and other tourist attractions. The national park development plan has approved up to

250 more rooms, 110 of which should become available from developments within the next year or so. In addition, the national park also operates 238 fully-served or semi-served camp sites at the townsite, 129 semi-served sites at the Crandell Mountain campground, and 24 at the Belly River campground.

### **Income and benefits to local communities**

*Indicate for the activities described above whether the local communities derive any income directly or indirectly and through what mechanism.*

One estimate has placed the economic impact of the national park at over Can.\$40 million, in 1994, based on tourist expenditure data. Park employment and other expenditures add some \$3 million more to the area's economy. There have been increases in the number of private bed and breakfast facilities, recreational ranch activities, and trail riding opportunities offered by individual ranch families adjacent to the park in recent years.

## **VI. RESEARCH AND MONITORING PROGRAMMES**

*Brief description and list of past research and/or monitoring activities.*

The annex from the 1994 Biosphere Reserve Nomination Form, used to summarize information on "Biosphere Reserves Surveys", is attached with appropriate summary information for the WBR.

In 1983, Canada/MAB funded the preparation of a bibliography to compile information on what was currently known at the time about the Waterton region and related resource management issues. For this purpose, the region was defined by a 50 km semi-circle around the national park on the Canadian side of the international border. Some 800 items are included in this compilation. The intent at the time was to provide an information base which could help identify opportunities for developing cooperative activities for the WBR. In 1984, a bibliography was prepared specifically for the national park, as part of a major background inventory.

Currently, with participation from the WBR and contributions of information from the national park, a "Crown of the Continent Electronic Data Atlas" is being constructed by a number of cooperating organizations. When completed it will include a "Dynamic Online Reference Information System" (DORIS), a geographic information system for the region covered, and a "Co-ordinated Research Program" to track research needs and opportunities. This can be accessed at <http://www.rockies.ca>

*Brief description of on-going research and/or monitoring activities.*

Over the past five years or so, the following kinds of research have been conducted in or around the national park, or are currently on-going:

Abiotic research:

Reconstructing Holocene environmental/climate changes in the southern Rocky Mountains, using tree ring chronologies; reconstructing Holocene vegetation and bison ranges; palaeoecological analyses of sediment cores.

Biotic research:

Flora: inventories of bryophytes, other non-vascular plants, and study of fungal diversity; pollination ecology of *Pentstemon lyalli*; DNA study of *Senecia conterminus*; other (unspecified) work on glacial lilies and native thistles; biocontrols study on spotted knapweed; re-analyses of vegetation in range enclosure plots; white pine blister rust in limber and whitebark pines; ecology of aspens.

Fauna: seasonal wildlife inventories, DNA analyses of hairs collected from grizzly bears to get information on population numbers and genetics; banding of rosy finches (*Leucosticte arctoa*); tick collections; survival and movement of the Belly River wolf pack; ecology and distribution of elk in the Waterton Pincher Creek area; survey of vectors of Dutch elm disease; study of long-toed salamanders (*Ambystoma macrodactylum*); population dynamics of bull trout (*Salvelinus malma*); genetic analyses of native fish; crustacean sampling for contaminant analyses; toxaphene and PCBs in fish.

Socio-economic research:

Archaeological assessments and inventory; mountain lion (cougar) /human interactions; user surveys for Crandell campground and backcountry trails; impact of horseback riding on trails.

Monitoring from within the national park is done every five to ten years to detect longer-term changes in ecological processes or conditions, and annually for selected flora and fauna [Van Tighem 1997].

Ten year intervals: Vegetation analyses of enclosure plots on ranchlands to assess grazing impacts and the encroachment of woody plants or 'weeds'; DNA inventory of bears to assess genetic diversity, population size and population structure.

Five year intervals: Aspen/bush encroachment on prairie areas (air photo analyses); disturbed areas inventory (linear disturbances, stream manipulations, vegetation recovery); fire returns inventories in each of three main ecoregions; habitat fragmentation by roads or habitat changes (GIS analyses of satellite imagery); changes in riparian vegetation; trace contaminants in fish tissues.

Annually: Plants: invasive exotics, e.g. knapweed (*Centaurea* sp.), toadflax (*Linaria* sp.); forest health (insects and disease). Birds: Christmas count; breeding bird transects (8); raptor surveys including survey of fledged young, for ospreys (*Pandion haliaetus*), bald eagles (*Haliaeetus leucocephalus*), golden eagles (*Aquila chrysaetos*) and prairie falcons (*Falco mexicanus*); surveys of sharp-tailed grouse (*Tympanuchus phasianellus*) leks; census of trumpeter swans, harlequin ducks (*H. histrionicus*) and Vaux's swifts (*Chaetura vauxi*). Amphibians and reptiles. Transects to record frog calls; benchmark inventories for chorus frogs (*Pseudacris triseriata*), leopard frogs (*Rana pipiens*), spotted frogs (*Rana pretiosa*), western toads (*Bufo boreas*), long-toed salamanders (*Ambystoma macrodactylum*), and garter snakes (*Thamnophis sirtalis*). Mammals: ground surveys of elk, mule deer (*Odocoileus hemionus*), bighorn sheep; compilation of weekly sightings of bears and mountain lions; benchmark counts of muskrats (*Ondatra zibethica*), beavers (*Castor canadensis*), and pocket gophers (*Thomomys talpoides*). Fish: population indices for bull trout.

Regular surveys are made of visitor satisfaction and awareness, and on environmental management activities associated with park facilities and administration (e.g. recycling).

Two biodiversity inventory and monitoring plots have been set up in the WBR within the past year or so. One, located in a spruce-fir forest site at the Continental Divide near Akamina Pass, uses the forest tree protocols developed by the Smithsonian Institution and UNESCO/MAB (SI/MAB). This higher altitude site might pick up early signs of climate change. Inventories of the trees on the forest site will be conducted by local high school students under supervision in September 1997. The other site is in the prairie grasslands near the east boundary of the park, located conveniently close to ranchlands where it could serve as a potential benchmark site for range studies. Plant inventories of the prairie site will use protocols being developed by an expert working group for EMAN. Some other plots or transects have been established in the park to monitor huckleberry production, knapweed growth, and the vegetation composition of range inside the 'buffalo paddock' (where a small herd of buffalo is kept in semi-captivity for visitors to see).

The WLNP is currently developing an "ecosystem science plan" to guide research and monitoring, in part to meet statutory requirements under the 1988 amendments to the National Parks Act that require park managers to maintain the 'ecological integrity' of park ecosystems. The plan is conceived at different spatial scales with varying degrees of involvement by park staff. The scales include the Crown of the Continent Ecosystem, the Chinook Ecological Region (represented by WLNP and Glacier National Park, as areas where the foothills are virtually absent along the east slopes) and the park itself. Details are still being worked out.

*Estimated number of national scientists participating in research within the Biosphere Reserve on a permanent or occasional basis.*

There are no permanently assigned scientists to the WBR. Research is conducted by university personnel (especially graduate students, and summer students on contract with the park), and research or monitoring is conducted by park wardens, or staff from other federal or provincial government agencies. Some tasks are performed by volunteers, e.g. bird censuses.

*Estimated number of foreign scientists participating in research within the Biosphere Reserve on a permanent or occasional basis.*

Some research has been carried out by Americans, in cooperation with the WBR or park staff, on the same basis as noted above.

*Research station(s) within the Biosphere Reserve.*

There is no special research station within the WBR, but personnel can share office and other space used by park wardens and naturalists assigned to interpretive services for visitors. The idea of establishing a "Waterton Institute" using the facilities of a school at the townsite is being explored.

*Permanent research station(s) outside the Biosphere Reserve.*

Agriculture and Agri-Food Canada maintains a major research facility at Lethbridge, Alberta, (130 km east of Waterton) that conducts work on crops, range, and veterinary medicine. Personnel from this facility were involved with work in the WBR during the 1980s. Ecological research within the Crown of the Continent ecosystem is conducted by the US National Biological Survey based in West Glacier, Montana.

*Research facilities of research station(s) (meteorological and/or hydrological station, experimental plots, laboratory, library, vehicles, computers etc...).*

As noted, WBR does have meteorological stations, and there is a hydrometry network maintained in cooperation with the provincial government. Some experimental plots, including now SI/MAB, and some permanent transects have been set up. The wardens' offices have a small library, computers and other office equipment, and vehicles. Laboratory services would have to be sought from elsewhere. Depending upon what was required, they may be obtainable from the University of Lethbridge, or Lethbridge Community College.

*Other facilities (e.g. facilities for lodging or for overnight accommodation for scientists etc...).*

Commercial accommodation is available at the townsite, as are serviced camp grounds.

**Indicate how the results of research programmes have been taken into account in the management of the biosphere reserve**

Some of the earlier work in the 1980s has led to management changes. The forage test plots resulted in a much greater use of 'meadow brome' as a hay grass in the zone of cooperation than was previously the case. The hunting season for elk was modified to become three shorter seasons throughout the fall and winter that serves to reduce the impact of elk on feed supplies set out for cattle. The study of animal health confirmed that the area remains free of tuberculosis and brucellosis, something that had been of concern to ranchers. Some of the work on elk has influenced management decisions elsewhere in the Crown of the Continent region. Monitoring studies of the movements of wolves provided a basis for urging restrictions on the killing of wolves.

Population studies of bull trout provided the basis for regulations to permit only a catch-release sports fishery, i.e. 'zero kill'. Work on possible losses of trout populations because of drawdowns of water for irrigation purposes is expected to lead to consultations with agriculturalists about how this might be remediated.

**VII. EDUCATION, TRAINING AND PUBLIC AWARENESS PROGRAMMES**

### **Describe the types of activities related to**

Environmental education and public awareness:

The WBA organizes, or helps co-sponsor public seminars or forums on matters that attract local community interest or concerns. Members of the WBA meet with local school groups, arrange outings for students, and give talks to community groups on topics associated with the biosphere reserve.

The Waterton Natural History Association (WNHA) was formed in the mid-1980s to take on some of the responsibilities for interpretative programs formerly offered by the park staff. It now offers a wide array of information and publications about the history and natural history of the Waterton area and the Rocky Mountains generally, and its "Heritage Education Program" offers a series of day-long field courses on different aspects of the natural history of the national park or Waterton area. The WNHA, WBA and other organizations have sponsored the Waterton-Glacier International Writers' Workshop on two occasions (so far). Professional writers are brought in to meet with 'promising writers' (the participants) to give talks and individual instruction on 'story opportunities' organized around field excursions to various sites within the region.

The national park maintains a communications program for visitors and local residents, on matters pertaining more closely to park management. Staff have encountered some confusion among visitors about the different international designations (International Peace Park, Biosphere Reserve, and now, World Heritage Site) which some people assume to be three additional layers of bureaucracy. In response, staff point to the need to transcend boundaries in order to deal with issues such as wildlife conservation, and this is reported to be more understandable to the public than descriptions of conceptual difference among the designations.

Training programmes for specialists:

During the 1980s some members of the management committee made an official visit to Tibet to advise on livestock and range management, and one spent a number of months over a several year period teaching in Peru and advising on the Manus Biosphere Reserve. The WBA meets with professional staff from parks, resource agencies, or biosphere reserves from elsewhere in Canada, or the world, who have occasion to visit Waterton, but it does not offer special training programs.

**Indicate whether there are facilities for education and training activities, as well as visitors' centres for the public**

There are two centres operated by the Waterton Natural History Association, and meeting rooms available in park facilities or in resort hotels. Some commercial 'ecotour' operations provide informative background information about the areas visited by their customers.

**VIII. INSTITUTIONAL ASPECTS**

**State, Province, Region or other administrative units**

*List in hierarchical order administrative entitie(s) in which the Biosphere Reserve is located (e.g. state(s), counties, districts).*

Federal government (Waterton Lakes National Park component), Alberta government, and Municipal Districts of Pincher Creek and Cardston (for zone of cooperation of WBR)

**Management plan/policy**

*Indicate if a management plan or policy exists for the overall biosphere reserve.*

*If yes, briefly describe the main characteristics of this plan and precise the modes of application.*

Because of the divided jurisdictions and the extent of private land ownership within the WBR, there is no overall biosphere reserve management plan or policy in place. Biosphere reserve functions have to be carried out on a voluntary coordination basis. This is the main challenge of the WBA.

The main policies and plans which are associated with the WBR, and with other adjacent areas to the WLNP are:

- \* Waterton Lakes National Park *Management Plan*, 1992 [Annex 2]
- \* Municipal District of Pincher Creek (No. 9), *Municipal Development Plan*, Draft June 1997. The goal of this plan is: "to protect and conserve agricultural land for agricultural use to the fullest extent possible without unduly restricting economic diversification or non-agricultural development". Its

objectives include: "To conserve and protect agricultural land, including foothills grazing lands, for extensive agriculture by: (a) minimizing conflicts from non-agricultural uses; (b) discouraging the fragmentation of agricultural and grazing land into small non-agricultural parcels; (c) ensuring that agricultural lots or parcels remain as large as possible; and (d) endeavouring to maintain traditional ranching activities", and: "To protect and conserve the natural scenic attributes of foothills grazing lands".

A previous plan gave recognition to a protection zone along the national park boundary which was intended to help protect the natural scenic attributes of the foothills grazing lands. The WBA has some concerns about its absence from the new draft plan.

\* Municipal District of Cardston (No. 6). The municipal district plan is being revised but as of mid-1997 it had not been released for public review. The WBA does not expect it to contain special provisions to protect areas adjacent to the national park from disruptive land use changes.

\* *Assessment of Management Considerations Required to Initiate the Development and Implementation of a Sustainable Forest Management Plan on Blood Reserve 148A (Timber Limit)*. This timber management plan is being revised, with informal help from park staff, to adopt a forest ecosystem management perspective.

\* *Akamina-Kishinena Class 'A' Provincial Park*. In 1996, after considering a number of options, the government of British Columbia made the decision to create this 10,921 ha wilderness park which lies immediately adjacent to WLNP and Glacier National Park. This effectively adds to the 'core' areas of the two national parks.

\* *Land and Resource Management Direction Within the Cranbrook Forest District, Appendix 3 to the Kootenay/Boundary Land Use Plan, Implementation Strategy*. Draft, October 1996. The plan resulted from stakeholder consultations convened by the British Columbia Commission on Resources and Environment (CORE). Portions of this plan provide management guidelines for management units beyond the Akamina-Kishinena park, immediately west of the Continental Divide adjacent to WLNP and Glacier National Park, i.e. the Flathead River Corridor (C-S05) and the Sage/Commerce Creeks (C-103). For both of these management units, the conservation of biodiversity and protection of grizzly bear habitats are major components.

\* *Castle River Subregional Integrated Resource Plan, Access Management Plan for the Castle Area*, 1992, and the *Castle Candidate Area* (for a "Special Places" designation), 1997. These pertain to a 74,000 ha area of the Rockies in Alberta immediately north of WLNP which had been part of the national

park until 1921. The general objective has been to strive for some balance among wildlife and wilderness protection, hunting, harvesting of timber, controlled grazing, oil and gas production, tourism development, and motorized ('all-terrain' vehicles) recreation. Consultation processes in one form or another have been underway for almost a decade, and the final outcome is still not clear. The Special Places designation would conform to the zoning for 'prime protection' and 'critical wildlife' areas at the higher and less accessible elevations specified in the Integrated Resources Plan, restrict motorized access in the 'front canyons', and create a provincial ecological reserve for the West Castle Wetlands.

As noted in Section IV, viewed from the perspective of conservation and resource management that includes areas all around the WLNP (Glacier National Park would be an impressive 'addition' to the core areas), the biosphere reserve concept may be emerging into a functional reality at this much larger spatial scale.

Authority in charge of administration of the whole, i.e. of implementation of this plan/policy: Not applicable.

Total number of staff of Biosphere Reserve:

There are no full-time staff *per se*. The work is carried out by volunteers, and by contract or permanent staff in other organizations working on projects initiated or supported by the WBA.

Financial source(s) and yearly budget:

Parks Canada provides \$5,000 per year to help cover expenses of the WBA. Other funds are tied to particular projects, e.g. \$5,000 per year since 1996 along with staff services from the Ecological Monitoring and Assessment Network (EMAN) to establish the participation of the WBR in the national biodiversity monitoring program. WBA has been getting along on an annual budget in the order of from \$7,000 to \$10,000 per year, not counting the contributions in kind it receives from staff of other organizations and its volunteers.

*Indicate the source and the relative percentage of the funding e.g. from national, regional, local administrations, private funding, international sources etc.) and the estimated yearly budget in the national currency.*

Authority in charge of administration of each zone:

Core area(s): Waterton Lakes National Park

Buffer zone(s): Waterton Lakes National Park

This reflects the zoning interpretations noted in Section IV, not the larger scale concept which seems to be emerging.

Mechanisms of consultation and coordination among these different authorities:

WBA does this through the involvement of its volunteers in other networks. Current examples include: Waterton Lakes National Park Advisory Board; the Crown of the Continent Society, and a spinoff project to create the Crown of the Continent Environmental Data Atlas; the Shell Canada Resources Round Table to address issues of natural gas processing and the reclamation of abandoned oil sites; participation in a Prairie Conservation Action Plan, development of an Ecosystem Management Framework Agreement among agencies in the Crown of the Continent region.

Where appropriate, National (or State, or Provincial) administrations to which the biosphere reserve reports:

The WBA reports informally to Canada/MAB.

#### **Mechanism for consultation of local communities**

*Indicate how and to what extent local people living within or near the Biosphere Reserve.*

Have been associated with the biosphere reserve nomination:

There is no record to suggest consultations were held prior to the original submission in 1979.

Participate in the decision process and management resources:

The WBR solicits involvement of people in its work, and meetings are open to those who are willing to put in the time.

**Indicate whether you consider the participation of local communities to be satisfactory, and, if not, what measures are envisaged to improve this situation**

The WBA recognizes that more local involvement in its activities would be desirable. Local support and interest varies considerably with the particular issues brought forth at seminars or public forums. There is hope that the collaborative efforts now underway to develop a regional scale geographic information system (as part of the "Crown of the Continent Electronic Data Atlas") will allow problems and opportunities to be demonstrated more powerfully and convincingly to the general public and politicians than would discussions of research findings.

The WBA has always to judge the extent to which it gets involved in 'management issues', especially those which government agencies or the private sector believe are best left to them. This requires a fine balance between advocacy for conservation and sustainable resource use generally, and addressing issues where this is not being done. The changing context within which the WBA now operates is being interpreted positively to mean greater opportunities to build relationships and cooperative endeavours than was the case before.

### **Protection regime of the core area and possibly of the buffer zone**

*Indicate the type (e.g. under national legislation and date since the legal protection came into being and provide justifying documents...*

An Act to amend the National Parks Act, 1988, Revised Statutes of Canada, Chapter 39, Assented to 18 August 1988. [Annex 3].

Of particular interest in the amendments was Section 5.1.2: "maintenance of ecological integrity through the protection of natural resources shall be the first priority when considering park zoning and visitor use in a management plan". Schedule 1, Part II in the Act, specifies the legal boundaries for Waterton Lakes National Park.

### **Land tenure of each zone**

*Percentage of ownership in terms of national, state/provincial, local government, private, etc...*

Core Area(s): National, 100%

Buffer Zone(s): National, 100%

Transition Area(s): Private, ~100%

*Foreseen changes in land tenure.*

There are pressures to build residential or recreational developments on ranchlands adjacent to the national park.

*Is there a land acquisition programme, to purchase private lands, or plans for privatisation of public lands?*

Some ranchers are interested in forming a Land Trust that would help secure ranchlands.

## IX. CONCLUSION

### **Brief justification of the way in which the biosphere reserve fulfills each criteria of Article 4:**

[Note: This repeats the statements used in the first section of the review report, i.e. 'main findings and conclusions'. They are included here for the sake of completeness in the periodic review form].

1. Biosphere reserves should encompass a mosaic of ecological systems representative of major biogeographic regions, including a gradation of human interventions.

The WBR encompasses areas ranging from the mountains to the prairies that are representative of the 'eastern slopes' along a major section of the Rocky Mountains Biogeographic Province. The absence of extensive foothills that occur elsewhere along the eastern slopes makes the area somewhat unique. There is a marked gradation of human interventions in the prairie component of the biosphere reserve (outside of the national park), and in the recreational use of the national park component, ranging from a townsite with the full range of tourism facilities through to backcountry hiking trails.

2. Biosphere reserves should be significant for biological diversity conservation.

The steep environmental gradients from the Continental Divide to the prairies has created an unusually rich mosaic of habitats with their associated flora and fauna. The resulting species richness is considerably greater than comparable areas of the Rockies to the north.

**3.** Biosphere reserves should provide an opportunity to explore and demonstrate approaches to sustainable development on a regional scale.

Certainly the opportunities are there to explore or demonstrate sustainable resource use practices that are applicable on a regional scale. The WBR has focused mainly upon issues of range management and the reconciliation of wildlife protection with livestock production. Measures to control fire hazards from beetle-killed pine forests have been explored by national park staff. Private sector initiatives are developing ecotourism options that benefit from national parks along the Rocky Mountains, and in ways that can contribute to wildlife conservation, e.g. "Trail of the Great Bear".

**4.** Biosphere reserves should have an appropriate size to serve the three functions set out in Article 3.

The only size limitation of the WBR concerns the maintenance of viable populations of large carnivores. While it contributes to the support of mammals such as grizzly bears, mountain lions and wolverine, the WBR itself is far too small to maintain sufficiently large populations for them to be viable over the long-term. This is also the case with other national parks in the Rockies. This issue is being addressed by initiatives from different agencies and NGOs that place the conservation of large carnivores in the context of "greater ecosystems" such as "The Crown of the Continent", collaboration to develop carnivore conservation strategies for the Rocky Mountains in the United States and Canada (especially for grizzly bears), and a new "from Yellowstone to the Yukon" concept endorsed by some 80 organizations to promote wilderness protection and large animal conservation. These concepts envision a large regional network of protected areas connected by broad habitat corridors managed in ways to reduce negative impacts on the large mammals.

**5.** Biosphere reserves should include these functions through appropriate zonation.

The zonation in the national park management plan identifies the equivalent of core and buffer areas. The 'transition zone' is associated with the cooperative activities carried out with neighbouring ranchers on the east side of the national park. The more local focus of the WBR should be complemented by a larger regional perspective that takes into account the management of all lands adjacent to the national park. From this perspective, there is an enormous addition to the core function from the adjacent Glacier National Park/Biosphere Reserve in Montana; a modest addition to the core zone from the new Akamina-Kisamina Class 'A' Wilderness Park in British Columbia immediately adjacent to the west boundary of Waterton Lakes National Park; a mix of 'core' and potential 'zone of cooperation' uses in the Castle

Mountain area of the Crow-Bow Forest immediately north of the park, and forest management sites along the south-eastern boundary of the Park on the Blood Indian Reserve and at Poll Haven.

The pattern of resource management and use on these adjacent lands reflects a biosphere reserve concept at a much larger scale. The 1992 management plan for the national park recognizes the potential of viewing management issues and the role of the park from this larger perspective as well. The challenge for the next decade is to give this a firmer recognition through appropriate organizational arrangements to foster the degree of collaboration needed to maintain or achieve conservation objectives (e.g. for large carnivores) and sustainable resource use in areas outside of the parks.

6. Biosphere reserves should have organizational arrangements for the involvement and participation of various authorities and groups in carrying out the functions of biosphere reserves.

The WBA operates informally as a small group of volunteers, with a core of some 6-8 people taking the main initiatives. These individuals also help link WBR concerns to other informal networks of people or organizations devoted to particular conservation or resource use issues. (See Section VIII). It would be timely to find ways to place the WBA on a more formal base as a legal non-profit society that could help 'catalyze' activities among these various networks.

7. Biosphere reserves should have provisions for management of human use and activities in the buffer zones, a management policy or plan for the area of the biosphere reserve, a designated authority or mechanism to implement this policy or plan, and programs for research, monitoring, education & training.

The 'buffer zone' is not fully defined for the WBR, as noted in Section IV and Section VIII. The national park and all lands adjacent to it are administered under different policies and plans for land or resource use, by different jurisdictions, i.e. federal, provincial and municipal. While administered separately, there are some informal provisions for consultations, mainly on an *ad hoc* basis as the need arises.

Programs for research, monitoring, education and training are underway within the WBR. There is regular cooperation between the two national parks (Glacier and Waterton) to provide interpretive services for visitors. While there is recognition of the desirability for closer cooperation among land management agencies there are problems in obtaining the financial resources to do more than routine maintenance of existing programs.

**Does the biosphere reserve have cooperative activities with other biosphere reserves (exchanges of information and personnel, joint programmes, etc...).**

At the national level:

Under the Working Group on Biosphere Reserves convened by Canada/MAB, representatives of each biosphere reserve in Canada have been able to meet annually. Information is also exchanged by a periodic newsletter, and more recently through a Web site at <http://www.cciw.ca/mab/>

Through twinning and/or transboundary biosphere reserves:

Waterton Lakes National Park is twinned with the adjacent Glacier National Park in Montana through the International Peace Park designation in 1932, and the more recent World Heritage Site designation in 1995.

Within the World Network (including Regional Networks):

One participant of the WBR has spent considerable time at the Manus Biosphere Reserve in Peru. Two ranchers also visited Tibet to advise on livestock and range management issues. The WBA receives occasional visits from people associated with other biosphere reserves, and it gets requests for information from time-to-time.

**Obstacles encountered, measures to be taken and, if appropriate, assistance expected from the Secretariat**

The WBA is still perceived in some quarters to be an 'arm of the national park' with different degrees of scepticism about what this entails. Others remain uncertain about what the biosphere reserve concept is trying to achieve, especially since it has to work through staff in other organizations to achieve it. It is thought that this might be resolved if the WBA could look ahead to the kinds of 'products' it could produce and obtain staff resources to deliver them. These are all questions the WBA discuss among themselves as they decide on activities to pursue. For regional scale issues, the jurisdictional divisions of responsibility and the international context create numerous 'boundaries' that would have to be transcended through horizontal networks of communication and cooperation. The Montane Cordillera Ecological Science Cooperative and the Prairies Ecological Science Cooperative fostered by EMAN, and involving the WBR, may be fora where these issues can be raised from a broader perspective.

### **List of Figures and Unattached Annexes**

**Figure 1.** Location map for the Waterton Biosphere Reserve.

**Figure 2.** Jurisdictions over lands adjacent to Waterton Lakes National Park.

Note: The Akamina-Kishinena Provincial Recreation Area shown in Figure 2 has since been 'up-graded' to a Wilderness Park, and the Kootney/Boundary Land Use Plan applies to the area labelled as the Flathead Provincial Forest.

**Annex 1:** Map of Waterton Lakes National Park, 1:50,000

**Annex 2:** Waterton Lakes National Park Management Plan, 1992.

**Annex 3:** An Act to amend the National Parks Act, August 1988.

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## ANNEX

### Biosphere Reserves Survey

In order to encourage communication and the exchange of scientific information among Biosphere Reserves, a world wide data base on Biosphere Reserves is presently being created. The following entries provide information on the scientific activities, infrastructure and facilities of each Biosphere Reserve. Those interested in more detailed information may obtain this information from the designated contact individual for the Biosphere Reserve.

A number of a year behind a category indicates the year as of which (*sic*) scientific activities or recordings have started (e.g., Air quality: 1975). If not known or inappropriate, please indicate with an "X" behind the category that the category of activity applies to the Biosphere Reserve.

#### 1. BASIC RESOURCE INFORMATION

##### 1.1 BIOLOGICAL INVENTORY

Invertebrates:	X
Mammals:	X

Nonvascular plants:	X
Vascular plants:	X
Vertebrates other than mammals:	X Birds, Fish, Reptiles, Amphibians
Biological survey and collections:	X Herbarium (vascular plants) and insects.
1.2 ECOLOGICAL MONITORING	
Air quality:	N/A
Climate:	X several stations
Freshwater ecosystems:	
Groundwater hydrology:	
Marine ecosystems:	N/A
Paleoecology:	X
Precipitation chemistry:	
Surface hydrology:	X With Alberta Environmental Protection Agency
Vegetation data:	X (on-going)
Water quality:	X (annually)
1.3 RESOURCE MAPS	
Geological:	X
Land use:	X
Regional land tenure:	X
Soils	X
Topographic:	X
Vegetation:	X

Soils and vegetation integrated into the Ecological Land Classification (1997). Forest stand original maps.

#### 1.4 HISTORICAL RECORDS

Aerial photographs	X
Bibliography (number of references):	Being developed (DORIS)

	Bibliography (year of last revision):	1984	
	Geographic Information System:	X	
	History of scientific study:		
2.	<u>RESEARCH TOPICS</u>		
2.1	ECOSYSTEM CYCLES AND PROCESSES		
	Biogeochemical cycles:		
	Comparative ecological research:	X	
	Ecological succession:		X
	Ecosystem modelling:		X
	Fire history/effects:		X
	Hydrological cycle:		
	Sedimentation:		
2.2	SPECIES POPULATIONS		
	Pests and diseases:		X
	Rare/endangered species:	X	
	Wildlife population dynamics:		X
2.3	POLLUTION		
	Acidic deposition:		X (LRTAP plot)
	Atmospheric pollutants:	X	
	Pesticides:		
	Water pollutants:		
2.4	HUMAN SYSTEMS		
	Archaeology:	X	
	Cultural anthropology:	X	

	Demography/settlement patterns:	X	
	Ethnobiology:		X
	Land tenure/management:	X	
	Resource economics:		X
	Traditional land use system:		X
2.5	MANAGEMENT PRACTICES		
	Agricultural:		X
	Appropriate rural technology:		
	Ecosystem restoration:		X
	Genetic resource management:		X
	Mining reclamation:		
	Rangeland management:		X
	Recreation/tourism:		X
	Resource production technologies:	X	
	Soil conservation:		
	Watershed management:		X
3.	<u>SITE SUPPORT</u>		
3.1	INFRASTRUCTURE		
	Conference facilities:		X (commercial)
	Curatorial facilities:		
	Laboratory:		
	Library:		X
	Lodging for scientists:		X (commercial)
	Road access:		X
3.2	MONITORING AND RESEARCH FACILITIES		
	Air pollution station:		
	Hydrological station:		X (Alberta maintains)
	Permanent plots for lake/stream:	X	
	Permanent plots for vegetation:		X

Weather station: X

Permanent research staff: